STANDARD SPECIFICATION FOR DRY PIT, VERTICAL SEWAGE PUMPS

MOE SPEC. NO. 4

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Ontario
Ministry of the Environment

The Honourable
Jim Bradley
Minister

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Deputy Minister

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ONTARIO MINISTRY OF THE ENVIRONMENT

STANDARD SPECIFICATION NO. 4, ISSUE NO. 3
FOR
DRY PIT, VERTICAL SEWAGE PUMPS

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PROJECT ENGINEERING BRANCH

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ALVR

(b) If the component is specified as "equal to" a specific make and type, an alternative will be considered, provided it is listed in Table II Data Form deviations and provided it has a performance characteristic equal to that shown in the specification.

1.4.0 Alternatives:

If a bidder wishes to offer an alternative proposal, in addition to his proposal complying with this Specification, each such alternative must be clearly set out and the related price adjustment shall be stated for each alternative.

1.5.0 Documents:

.1 This Specification shall be read in conjunction with the following documents:

(a) General Terms and Conditions

(b) Invitation to Tender

(c) Form of Quotation

(d) Table I Data Form

(e) Table II Data Form

This Specification, together with the above-mentioned documents and any further documents issued therewith by the Ministry or its Consulting Engineers, shall comprise the quotation documents.

.2 General Terms and Conditions, included in the Supplement, shall be the governing terms and conditions accepted in the Form of Quotation by the Supplier. NOTE: The General Terms and Conditions will not be forwarded to the Supplier with the invitation to Tender. (The General Terms and Conditions are not included in this Draft Issue, and they would be issued separately, if this Specification were used.)

.3 Blank copies of: The Form of Quotation and Tables I and II Data Forms are included in the Supplements for reference and will be completed for specific requirements of the pumping equipment as follows:

(a) The Form of Quotation will be prepared by the Consulting Engineer and will be completed by the Supplier.

(b) The Table I Data Form will be prepared by the Consulting Engineer.

(c) The Table II Data Form, a questionnaire, shall be completed by the equipment supplier and returned with his quotation. All information requested on that form shall be submitted in addition to the bidder's supporting information, in order for the quotation to receive full consideration.

NOTE: In the supporting information, it is not necessary to submit a schedule of equipment equivalent to a copy of the Ministry's Technical Specification. Deletions, features additional to the specification, and descriptive information only are required for consideration as supporting information.

2.0 APPLICATION, METHOD OF OPERATING AND SERVICE:

NOTE: The purpose of this section is to inform the Supplier on how the Ministry will apply, operate and service the equipment. The Supplier shall ensure that the equipment offered will perform fully to the satisfaction of the Engineer and meet the duties and procedures given below.

2.1.0 Pump Application and Duties:

.1 The centrifugal pump units shall be capable of continuous operation in a dry pit.

.2 The pump units shall be capable of handling raw sewage at the flow requirements as specified in Table I Data Form.

.3 The pumps will be sized so that one pump will handle maximum design flow with the second pump of 100% standby capacity, unless otherwise noted in Table I Data Form.

.4 The design of the wet well will be such that a pump would be required to cycle (start, pump, stop) not exceeding six (6) times per hours. The pump would operate at the specified capacity and total head; the motor shall be suitable for this duty.

2.2.0 Method of Operation:

.1 The pumps will be controlled by an air bubbler system or by mercury liquid level float switches operating through the pump control panel. The sonic probe system is also an alternative.

.2 The operating (lead) pump is selected by a switch on the electrical control panel. This switch is manually operated, usually on a one or two day basis, so that the running hours on the pumps are on a 2:1 ratio approximately.

.3 It is intended that a properly operating pump would not be left idle longer than seven (7) days in order to meet the recommendations of the supplier of the pump shaft mechanical seal.

.4 The standby (lag) pump would operate in parallel with the lead pump under high flow conditions or in the event of a failure of the lead pump.

3.0 PUMP ASSEMBLY:

3.1.0 Arrangement:

(a) The pump shall be vertically mounted on a solid cast iron or fabricated steel supporting base or stool. The base shall permit good service access to the cleanout in the suction elbow.

(b) The electric motor shall be mounted on a power frame or pedestal located on top of the pump, or a floor above. Provide service access in the pedestal for the flexible coupling and shaft seal connection.

3.2.0 Pump Size Selection:

(a) It is recommended that the guarantee operating point for the 20-year flow be within the maximum efficiency area on the head/capacity performance curve. The pump shall also operate satisfactorily without appreciable loss in efficiency or undue mechanical stresses and vibrations at any point plus and minus 25 percent of the above guaranteed capacity point.

NOTE: The pump H/Q performance curve submitted with Table II Data Form shall indicate the limits of the usable part of the curve for consideration of the above

requirements. The portions of the curve to the extreme left and right of the line of maximum efficiency, where turbulence and cavitation would be evident, would not be considered usable.

(b) The efficiency of the pump shall be a criterion in the pump adjudication.

(c) Ensure that the bearings, shaft and frame are of adequate size to deal with radial thrust and vibration caused by the pump operating away from the design point. These may be caused by:

i) The delay in establishing the flow in long forcemains during the pump start-up period.
ii) Continued low speed operation of the pump when using variable speed drives.

(d) The discharge nozzle configuration shall be such that turbulence and noise is not generated.

(e) Recommended pipe flange sizes (mm diameter): 100, 150, 200, 250, 300, 350, 400, 450, etc.

Note: If 125 mm flange diameters are supplied, provide "reducers" to 150 or 200 mm size.

3.3.0 Pump Speed shall be as given in Table I Data Form.

3.4.0 Pump Shaft Coupling:

(a) The coupling used for the connection of pump and motor shafts shall be flexible type equal to "Steelflex" Type "T" as manufactured by Falk. Alignment shall be within 0.05 mm.

(b) Pin and rubber buffer type flexible couplings are permitted on pump units driven by motors up to 37 kW operating at 1200 r.p.m. synchronous speed.

3.5.0 Pump Assembly Vibration:

The pump assembly shall be properly aligned and mounted so that the vibrations do not exceed 0.13 mm/m (1.5 mils per foot) distance above the mounting flange, in the operating speed range.

4.0 PUMP UNIT:

4.1.0 Pump Casing:

(a) The pump casing shall be a single volute type of heavy cast iron construction, with all openings and passages large enough to pass a 75 mm minimum diameter sphere. A manufacturer's label shall be rivited to the casing with the following embossed information: Model or type, serial No., design capacity, head, RPM, bearing make and types, and date of manufacture.

(b) Suitable NPT openings complete with air vent valves shall be provided at the high points of the pump casing and of the seal housing, to permit the release of any trapped air.

(c) The discharge nozzle shall be flange drilled and sized to ANSI B16.1 Class 125. A discharge nozzle offset on the volute is desirable.

NOTE: The arrangement of the offset discharge nozzles of the two pumps shall be "left-hand" and "right-hand" to provide maximum working space in the piping layout.

(d) An inspection port or clean-out on the volute of the pump is required to permit access to the impeller without dismantling the pump.

4.2.0 Suction Elbow:

(a) The elbow shall be 90°, flange drilled and sized to ANSI B16.1 Class 125 and with clean-out.

(b) Provide a 25 mm short nipple with a Class 125 bronze cock (equal to Crane No. 250) with NPT plug on the elbow clean-out cover. This shall be compact to avoid damage during operation, but accessible when required for draining the pump.

(c) A reducing type elbow is recommended.

4.3.0 Pump Impeller:

(a) The pump impeller shall be of the non-clog enclosed type, suitable for pumping raw sewage, made of cast iron and shall be in static and dynamic balance.

(b) The impeller shall be keyed and firmly secured to the pump shaft by a suitable self-locking device. The impeller shall be readily removable without the use of special tools.

4.4.0 Pump Shaft:

(a) The pump shaft shall be of carbon steel conforming to S.A.E. 1045 or equivalent.

(b) It shall be fitted with a pressed-on Type 316 stainless steel shaft sleeve with a finish of 15 to 25 RMS.

4.5.0 Pump Bearings:

(a) The pump bearings shall be of anti-friction, greaseable type, with alemite fittings suitably selected to carry radial and axial loads, (due to unbalanced hydraulic forces on the impeller) for a minimum bearing life of 50,000 hours, B10 life under maximum load conditions.

4.6.0 Pump Shaft Mechanical Seal

.1 Provide a single mechanical seal suitable for:

(a) Raw sewage or sludge application.

(b) Mounting on a stainless steel shaft or shaft sleeve.

(c) Service without external water connection.

.2 Provide the single mechanical seal with the following:

(a) Seal faces - both seal faces to be solid tungsten carbide. Hydraulically balanced for pumps with a design discharge pressure over 350 kPa (50 psi). Below 350 kPa seals may be unbalanced.

(b) Sleeve or barrel - rubber diaphragm bellows mounted on the shaft and/or secured with stainless steel set screws, readily accessible, (through seal housing if necessary).

(c) Spring(s) - single stainless steel non-clogging exposed to the fluid or small multi-springs shielded from the fluid.

(d) Gland plate of stainless steel.

(e) Two plugs for alemite grease fittings in the pump seal housing diametrically opposite to provide optional grease lubrication to the seal faces.

(f) Packed with linseed soap prior to shipment to exclude dust and provide lubricant during installation, etc.

.3 Equal to John Crane Type 1 Code BD-1D1 (unbalanced) or Type 1B (balanced), Chesterton 880, Durametallic Type ARO, or Tyton Series TH870.

.4 Note: The throat bushing may be omitted so as to provide cooling of the seal from the fluid pumped. This is at the discretion of the pump supplier.

4.7.0 Pump Casing and Impeller Wearing Rings:

(a) Removable wearing rings shall be supplied where indicated in Table I Data Form.

(b) The wearing rings shall be AISI Type 304 stainless steel.

4.8.0 Flexible Shafting

(a) Lengths of flexible shafting shall be of the universal-joint type with needle bearings, complete with shielded grease lubricated steady bearings, flanges and splines, between each driver and pump. The steady bearings shall be rated for 50,000 hours, B-10 life. The shafting shall be balanced, and designed for continuous duty to compensate for misalignment of the pump and drive. The weight of the shafting shall be carried by the bearings of the drive unit above. The flexible shafting shall be Hayes-Dana Series 1900 or approved equal.

(b) Safety guards of expanded aluminum metal or galvanized steel shall be furnished around the coupling and shaft immediately above the pumps and at service walkways adjacent to steady bearings.

5.0 PUMP MOTORS:

5.1.0 Motor Size:

The motors shall be of sufficient capacity to operate the pumps listed in Table I Data Form. The motors shall be of sufficient size to meet the horsepower requirements of the selected

impeller curve, where it intersects the lower of the two system curves (C = 140) included with Table I Data Form. The motors shall comply with EEMAC Standards MG-1 and be CSA approved and shall not be loaded above 90% of the nameplate rating operating up to 20% above the pump specified design flow, using a forcemain "C" valve of 130.

5.2.0 Mechanical Requirements:

The motors shall have the following mechanical requirements:

(a) Vertical solid shaft, drip-proof enclosure with safety hood.

(b) Speed and torque curve compatible with the pump demand.

(c) Greaseable (unshielded open type) bearings, 50,000 hours, B10 life with alemite fittings and relief plugs.

(d) Terminal box, 4-position gasketed, large cast iron type.

(e) Heavy lifting eye(s) capable of supporting the complete pump assembly.

(f) Noise not to exceed EEMAC recommended levels.

(g) Balance not to exceed the vibration limits of MG-1 - 12.05.

(h) Supported by a "C", "D" or "P" type flange.

5.3.0 Electrical Requirements:

The motors shall have the following electrical requirements:

(a) Squirrel-cage induction, constant speed, design B performance.

(b) Continuous rating with 1.15 service factor.

(c) Suitable for 600 V., 3 phase, 60 Hz service, unless revised in Table I Data Form.

(d) Windings with Class F insulation or better (but not encapsulated) and suitable for an ambient temperature of 40°C, and especially impregnated for moist conditions.

(e) Insulation resistance not less than 10 Megohms, measure with a 500 V. "megger", as a field test.

(f) On motors over 56 kW provide 3 thermisters, 1 per phase, in the windings for thermal protection. Provide thermister control unit for inclusion in starter or MCC "by others".

(g) On motors over 75kW, provide stators with random windings , rotors with copper bars and copper end resistance rings and motor frames of cast iron or fabricated steel.

6.0 FACTORY TESTS & COMMISSIONING, ETC.:

6.1.0 Factory Tests:

.1 Non-witnessed tests of each pump assembly, in conjunction with a factory test panel shall be performed at the factory before shipment in accordance with the Hydraulic Institute Standards, Centrifugal Pumps Test Code.

.2 The test equipment shall include:

(a) A test tank adequately filled with water with a control valve in the discharge line.

(b) Flow and head measuring devices.

(c) Voltage and current measuring devices.

.3 The report shall include the following findings:

(a) Head and quantity readings at five (5) capacity points, i.e., shutoff, run out, approx. design point and two other points.

(b) Motor Ampere & Voltage readings at the above capacity points.

(c) Motor HP readings at the above capacity points calculated from the motor performance figures.

(d) Impeller direction of rotation viewed looking down on the pump.

(e) Produce certified pumps performance curves from the above data including the Impeller Part No. and exact diameter (for reordering purposes).

.4 The test report shall be certified by the Supplier and three (3) copies shall be forwarded to the Purchaser for distribution to the Consulting Engineer before the equipment is delivered to the site.

.5 If the efficiency of the pump or motor is more than 3% below that guaranteed, the Ministry reserves the right to reject the equipment.

6.1.5 One copy of the report shall be included in each "Installation Instruction Manual". See Clause 8.5.1.

6.2.0 Note Re: Installation:

.1 Installation of the sewage pumping equipment in a concrete type underground dry well will be carried out by the general contractor or his mechanical sub-contractor.

6.3.0 Commissioning:

.1 When the contractor has completed his installation work and before any equipment is operated, he shall instruct the Supplier to commission the equipment. The Supplier shall provide the services of a skilled technical representative for a minimum period of two days (16 hours) at the site to carry out the following work:

(a) Check the installation as to its workmanship.

(b) Check the control including the supply voltage, heater overload settings and wiring connections. Mark the pump overload settings on the pump schematic diagram, date and sign.

(c) Check the pump operation including impeller rotation.

(d) Perform further tests as directed by the Engineer.

(e) Instruct the plant personnel in the operation and service of the equipment.

7.0 PAINTING, PACKING & SHIPMENT:

7.1.0 Painting, etc.:

.1 All ferrous surfaces of the pump units and auxiliary equipment shall be cleaned at the factory by commercial type sand blasting in accordance with SSPC-SP6 requirements. The

surface shall then be factory painted with a primer coat and compatible finish coats of paint suitable to provide protection against corrosion conditions.

7.2.0 Packing:

.1 The Supplier shall provide packing to protect the equipment against frost, corrosion, dampness, heavy rain, breakage or injury, or loss of components during transit to its destination. The packing shall also be acceptable to the transportation companies.

7.3.0 Shipment:

.1 The Supplier shall not ship the equipment from his plant except by prior agreement with the Consulting Engineer and the Purchaser.

8.0 DRAWINGS & MANUALS REQUIRED:

NOTE: The word "Purchaser" in this section shall mean the Purchaser who issued the purchase order on the Supplier.

8.1.0 Information Required. The Supplier shall provide the following:

(a) Installation Shop Drawings.

(b) Installation Instructions.

(c) Maintenance Instructions.

(d) Performance Curve of Each Pump.

8.2.0 Installation Shop Drawings. The information given in these drawings shall include:

.1 General Arrangement.

8.3.0 Information on Shop Drawings shall include:

.1 MOE Project Name and No.

.2 Supplier's Name, Order No., Certifying Signature and Phone No.

.3 Drawing No., Issue No., & Date of Issue.

8.4.0 Installation Instructions:

The instructions shall apply specifically to the equipment supplied, i.e., Model No., type and configuration.

8.5.0 Distribution of Shop Drawings and Installation Instructions, etc.

.1 Unless otherwise directed by the Consulting Engineer, the Supplier shall forward five sets of the above drawings and instructions to the Purchaser with a transmittal sheet including the following information and directions required by the Ministry.

(a) Mark sheet "Shop Drawing & Installation Instructions, etc.".

(b) MOE Project No., Name & Jobsite, etc.

(c) One (1) set to be retained by the Purchaser.

(d) Four (4) sets shall be forwarded by the Purchaser to the Consulting Engineer.

(e) Request the Consulting Engineer to indicate his approval or his comments and return three (3) sets to the Purchaser.

(f) Of the three approved sets held by the Purchaser, one set approved or "noted" by the Consulting Engineer shall be returned to the Supplier, and the remaining two approved sets passed to the Jobsite. Resident Engineer to hand them to the operating staff.

.2 The Purchaser shall take up any comments made by the Consulting Engineer and resolve the issues to the satisfaction of the Engineer.

.3 One set of Shop Drawings and Installation Instructions, etc. shall be placed in a stiff cover folder by the Supplier and marked "CONSTRUCTION COPY. DO NOT REMOVE FROM SITE". This copy shall be shipped with the equipment and retained with the accessories.

MINISTRY OF THE ENVIRONMENT

F O R M O F Q U O T A T I O N

(See General Terms & Conditions for Preselected Equipment Clause GT2)

BY: _____

_____

TO: MINISTRY OF THE ENVIRONMENT, c/o _____

_____

FOR - MOE PROJECT NO. _____ CONTRACT NO. _____

_____

COVERING _____

_____

Q1.0 We, the above-named equipment supplier, having carefully examined the quotation documents issued by the Ministry's Consulting Engineer, including the General Terms and Conditions, Specifications and other related documents, if any, (see Clause Q4.0 below) herewith submit in duplicate and in accordance with the terms and conditions set out in the aforementioned documents our quotation for the equipment listed hereinafter.

Q2.0 We agree that, in case of any conflict between any of the terms and conditions set out in the documents which we submit together with this Form of Quotation and the terms and conditions set out in the quotation documents issued by the Ministry's Consulting Engineer, the provisions of the latter documents shall take precedence and shall govern.

Q3.0 We agree to the following requirements as noted in the Ministry of the Environment's General Terms and Conditions for Preselected Equipment, dated October, 1975:

.1 Validity period of this Quotation per Clause GT4.1 shall be _____ months from closing date for quotations of _____.

.2 Manuals, Parts lists, etc., per Clause GT 9.0, _____ sets to be supplied.

.3 Drawings per Clause GT 14.0, _____ prints to be supplied.

.4 Services Required at Site per Clause GT 16.0: The Supplier shall be responsible for: -

Minimum Requirements

No. of man days _____ No. of visits _____.

Q4.0 The quotation documents include the Ministry of the Environment's standard General Terms and Conditions for Preselected Equipment dated October, 1975, this Form of Quotation, _____

_____

Q5.0 EQUIPMENT QUOTATION LIST

.1 Item Description	
.2 Item Ref. Letter	
.3 Quantity	
.4 TOTAL PRICE for above item f.o.b. jobsite, Sales Taxes excluded.	
.5 Total price valid until	
.6 Delivery of Equipment - weeks (After receipt of order)	
.7 Shop Drawings in weeks	
Commissioning of Equipment	
.8 No. of man days in total price	
.9 No. of men/No. of visits	
.10 Extra price per man day for further commissioning	
Breakdown of Imported portion	
.11 Part imported	
.12 Country of Origin	
.13 Percentage of Total Price at point of Entry	
.14 Rate of Import Duty	
.15 Rate of Exchange	

(Name of Quotation Preparation Officer)

(Name & Signature of authorized signing officer)

(Date)

Affix Co. Seal

ONTARIO MINISTRY OF THE ENVIRONMENT

TABLE I DATA FORM

for

DRY PIT, CENTRIFUGAL, NON-CLOG, VERTICAL RAW SEWAGE PUMPS

for

M.O.E. Project No._____ Station No._____

Location & Jobsite _____

NOTES: (a) This table, prepared by the Consulting Engineer to the Guidelines in Appendix A1, covers the specific requirements of the equipment for the above project.
(b) Quotations must be in accordance with the Ministry's Standard Specification No. 4, Issue No. 3, dated March, 1986 and as supplemented by this Data Form.
(c) Each quotation must be accompanied by a properly completed Table II Data Form.
(d) See Clause 1.4.0 regarding alternatives.
(e) See Clause 1.5.2(c) regarding supporting information.

D I.1.0 Pump Performance Data for Each Pump

.1 Design Capacity_____L/s at_____m TH

.2 System Curve attached_____

.3 Length of forcemain _____m

D I.2.0 Pump Features

.1 Pump Speed_____rpm (synchronous)_____

_____

.2 Pump casing and impeller wearing rings required_____

D I.3.0 Electric Motor

.1 Power Supply_____V._____PH._____Hz.

D I.4.0 Special Requirements

Issued by_____

Date _____

ONTARIO MINISTRY OF THE ENVIRONMENT

TABLE II DATE FORM

for

DRY PIT, CENTRIFUGAL, NON-CLOG, VERTICAL RAW SEWAGE PUMPS

for

M.O.E. Project No._____Station No._____

Location & Jobsite_____

D II.1.0 Bidder's Reference:

.1 Bidder's Name, Address & Phone No._____

_____

.2 Bidder's Quotation No. & Date_____

_____

D II.2.0 Pump Data:

1. Make and Model/Number_____
2. Speed_____rpm. No. of pumps_____
3. Performance Curve No. attached_____
4. Design Capacity for Each Pump:
   _____L/s at_____m TH_____kW_____% Eff.

D II.3.0 Pump Mechanical Details:

1. Inlet orifice at volute - size_____
2. Suction Elbow Nozzle - size_____
3. - velocity at design flow_____ m/s
4. Discharge Nozzle - size_____
5. - velocity at design flow_____ m/s
6. Impeller - diameter for design flow_____
7. - maximum diameter_____
8. Shaft mechanical seal, make & type_____

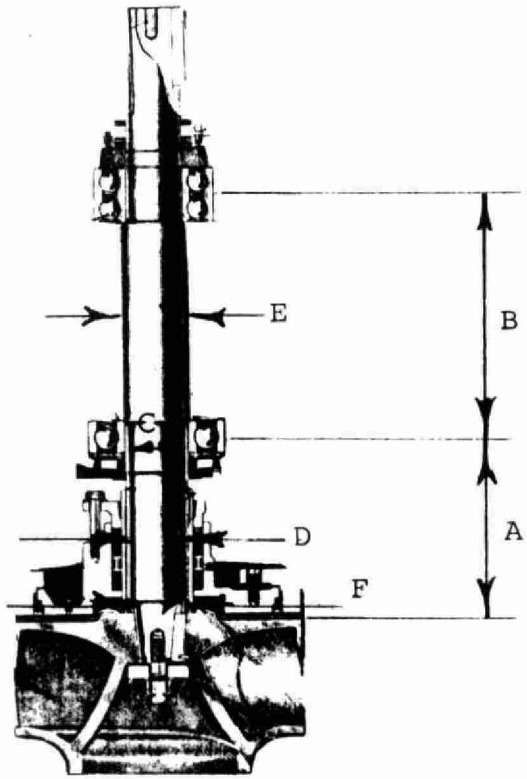
_____

9. Wearing ring material & hardness (if applicable)_____
10. Pump outline dimension drawing attached_____

_____

11. Weight-pump assembly less coupling _____Kg.

D II.4.0 Shaft-Bearing Dimensions:



A Impeller overhang _____ mm

B Distance between bearings _____ mm

C Shaft diameter at lower brg. _____ mm

D Shaft diameter at seal _____ mm

E Shaft diameter between brgs. _____ mm

F Shaft diameter at impeller _____ mm

G Keyway size and type _____

D II.5.0 Pump Motor Data:

.1 Make and type_____

.2 Nominal rating of motor offered_____kW

.3 Starting inrush current_____amps.

.4 Motor efficiency at full load_____%, 3/4 load_____%, ½ load_____%.

.5 Motor power factor at full load_____, 3/4 load _____, 1/2 load _____.

.6 Speed at rated full load _____RPM.

D II.6.0 Deviation:

List all exceptions to the Specification using a separate sheet if necessary. If none, say "NO DEVIATIONS".

D II.7.0 Alternatives (Submit in covering letter or separately)

See Clause 1.4.0. If none, say "NONE PROPOSED".

Submitted by _____

Signature & Date _____

_____

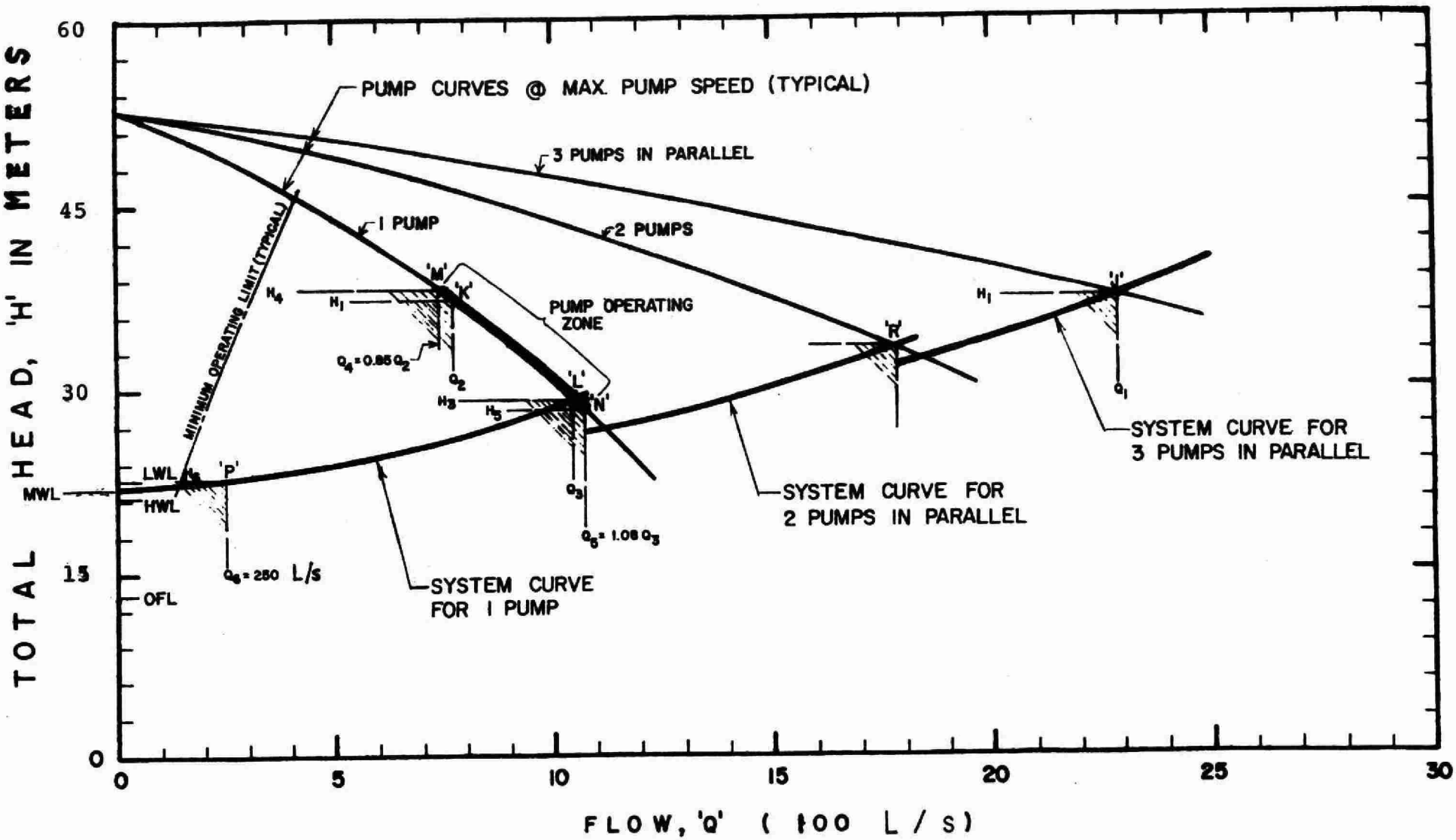


FIG. No. 1 DESIGN SYSTEM CURVE WITH TYPICAL PUMP CURVE AND PUMP OPERATING POINTS FOR 1, 2 OR 3 PUMPS IN PARALLEL

(SEE ATTACHED SHEET FOR NOTATIONS)

DESCRIPTION AND NOTATIONS

for

Fig. No. 1, DESIGN SYSTEM CURVE

(1) The system curves are for one, two, or three pumps of equal head and capacity operating in parallel. A fourth pump is installed for standby.

(2) The system curves are based on each pump pumping through its own suction and discharge piping into a common header and thence through a long forcemain to a drop manhole. The dynamic head is based on a Hazen-Williams friction factor of C=130, and the static head is based on the mean level between LWL and HWL in the wet well.

(3) The designated points are as follows:

(a) Point "J" is the System Design Point, which is the total for 3 pumps operating in parallel at maximum speed.

(b) Point "K" is the Pump Design Point for each one of 3 pumps operating in parallel at maximum speed.

(c) Point "L" is the Pump Duty Point for a single pump operating alone. Note: The pump performance guarantee shall be at this point, and a max. pump efficiency close to this point is desirable.

(d) Points "M" and "N" are the limits for the Pump Operating Zone where Q_4=85% of Q_2, and Q_5=108% of Q_3.

(e) Point "P" is the Minimum Operating Point for a variable speed pump.

(f) Point "R" shows a typical duty point for two pumps operating in parallel at maximum speed.

STANDARD SPECIFICATION NO.4
DRY PIT VERTICAL SEWAGE PUMPS
APPENDIX A1 - SELECTION GUIDELINES

A 1.0 GENERAL

A. These guidelines are to assist the Engineer in the preparation of Table 1 Data Form. The guidelines are generally in the same sequence as Table 1.

B. These DO NOT form part of the requirements of the Supplier or Contractor.

C. Notes for the preparation of this table include:

(a) Indicate project Data; e.g. MOE or Municipality references.

(b) Indicate Municipality, etc. and jobsite locations.

(c) Indicate where a component or feature is NOT required.

(d) Where practical, give all data in metric units and delete the imperial units.

(e) For electric motor data, note that:

- kW (mec) or kW (m) indicates the output power of the motor shaft; i.e. x 1.34 BHP
- KW (elect) or kW (e) indicates the electrical power to the motor terminals.

A 1.1 PUMP DATA

Design Capacity

A. The pump capacity required is usually based on 20-year peak flow requirements.

B. The typical formula for peak flow is:

$$Qpeak = \frac{(P \times q_{dom\text{-}avg} \times M) + (P \times q_{infilt\text{-}peak})}{86400}$$

where:

Qpeak* : Design Pump Capacity - (L/s)

P : Design Population - (persons)

$q_{dom\text{-}avg}$: Per Capita Flow-(average, domestic portion)
- (L/c.d) - typically 450 L/c.d**

1.0 SCOPE, DESIGN AND DOCUMENTS:

1.1.0 Scope:

.1 This Specification covers the general features of design, materials, manufacture, arrangement, protective coating, testing, shipment and commissioning of dry pit, centrifugal, non-clog, vertical raw sewage pumps with electric driving motors, frame mounted on the pumps, or with motors mounted on a floor above the pumps and connected by flexible shafting.

.2 This Specification is limited to:

(a) Arrangement requiring two or more sewage pumps.
(b) Electric motors of constant, single or variable speed design.
(c) The pump and motor assembly, i.e., exclusive of Control Equipment.

1.2.0 Design:

.1 The Supplier shall be responsible for the design, assembly and fabrication of the equipment to ensure that a reliable and efficient pumping operation is produced. It shall be in accordance with good engineering practice and comply with the National Standards and Codes referred to in this specification. The equipment supplied shall comply with the basic requirements and information stated and referred to in Table I Data Form.

All materials and equipment shall be new and of current manufacture.

.2 The bidder shall ensure that the dimensions, sizes and the details which he indicates in Table II Data Form or on drawings are correct for the size of the equipment offered and meet the condition indicated in Table I Data Form.

1.3.0 Substitution:

.1 Certain components in this specification are referred to by make and type, and substitution shall be accepted only as follows:

(a) If the component is specified as "Approved equal to" a specific make and type, no alternative is acceptable without written approval by the Ministry's Value Engineering Section.

NOTE: Revisions from Issue No.2 are marked by a vertical line at the left side of the clause.

$q_{infilt-peak}$: Per Capital Infiltration Allowance (peak) - (L/c.d) - typically 225 L/c.d***

M : Peaking Factor $M = 1 + \frac{14}{4 + \sqrt{\frac{P}{1000}}}$

$M \not> 4.0$

C. NOTES

(a) *The "firm" capacity of the pumping station for capacity rating purposes shall be the pumping capability of the system with the largest pump out of serve. In the case of a two-pump station, each pump should be capable of pumping peak flows.

(b) **In the absence of actual data to show otherwise, total average per capita flow is generally considered to be in the order of approx. 550 L/c.d, of which approx. 100 L/c.d is regarded as average extraneous flow with 450 L/c.d representing the domestic, commercial nominal industrial and institutional portion of the total.

(c) ***In the absence of actual data to show otherwise, peak per capita infiltration is generally considered to be in the order of approx. 225 L/c.d.

System Head Calculations

D. System head calculation should be undertaken in accordance with "Ministry Guidelines for the Design of Sanitary Sewage Systems", Clause 3.5.1, paras 1 & 2, which read as follows:

"3.5.1 System-Head Calculations

Par 1 Applications for approval should be accompanied with system-head calculations and curves for three conditions as follows:

(a) C = 120 and low water level in the wet well

(b) C = 130 and median water level over the normal operating range in the wet well.

(c) C = 140 and overflow water level in the wet well.

Par 2 Curve (b) should be used to select the pump and motor since this will reflect the normal operating condition. The extreme operating ranges will be given by the intersections of curves (a) and (c) with the selected pump curve. The pump and motor should be able to operate satisfactorily over this full range."

NOTE: The above-noted guidelines should also be referred to for additional information relating to the design of sewage pumping stations.

E. Example for Two-pump Station; i.e. 2 Peak Pumps

Population: 3500

$$M = 1 + \frac{14}{4 + \sqrt{\frac{3500}{1000}}} = 3.38$$

$$Qpeak = \frac{(3500 \times 450 \times 3.38) + (3500 \times 225)}{86400}$$

Qpeak = 70.7 L/s

Provide 2 pumps each rated at 70.7 L/s

F. Example for Three-pump Station; i.e. 1 Duty Pump, 2 Peak Pumps

NOTE: It is sometimes considered necessary to reduce the effects of peak flows in-surges to the treatment facility. One possible means of accomplishing this is by means of a "duty" pump normally sized for average day flow conditions in addition to the required peak flow pumps.

Population : 3500

Duty Pump Sizing: $\frac{3500 \times 550^{**}}{86400} = 22.3$ L/s

**(See Clause A1.1Cb)

Provide 3 pumps; 2 rated at 70.7 L/s; 1 rated at 22.3 L/s.

Pump Evaluation

G. Note that some pumps are custom assembled incorporating an impeller trimmed for the design point and a suitably sized motor, all for the specific project.

H. Some pumps are custom selected incorporating an untrimmed impeller which is nearest to the design

requirements. The selected impeller should provide a slightly higher Q at the required H unless the reverse is specifically required and stated in the "Special Requirements".

3 or 4 Pump Station

I. This equipment specification is based on a 2-pump station where the capacity for each pump is suitable for the 20-year peak flow.

J. If this arrangement is not suitable, a 3- or 4-pump station might be considered for the following reasons:

(a) In addition to the 2 pumps sized for the peak flows, a 3rd pump is provided to carry normal flows and is called the duty pump.

(b) Three equally sized pumps are provided so that 2 pumps operating in parallel handle the peak flow. This provides staged pumping and each pump represents 50% spare capacity. NOTE: Verify from the pump and system curves that there is a sufficient increase in flow during parallel operation to justify this arrangement.

(c) Four equally sized pumps are provided so that 3 pumps operating in parallel handle the peak flow. This provides staged pumping to a greater degree than (b) above but the application is usually limited to system heads which are almost all static.

A 1.2 PUMP FEATURES

A. Pump Speed

(a) The recommended maximum synchronous speed is 1200 rpm. This covers most of Ministry of the Environment applications.

(b) A synchronous speed of 1800 rpm will be considered at special flow conditions, i.e., at relatively low capacity and high total head (e.g. 35 L/s at 30 m TH), where a 1200 rpm pump is either not available or its efficiency is low.

In these special cases, add - e.g. "The alternative speed of 1800 rpm maximum will be considered".

(c) Synchronous speeds of 900 and 720 rpm will be applicable at low heads and both low or high capacities, e.g.:-

- 13 L/s at 7 m TH in the case of 900 rpm.
- 65 L/s at 10 m TH in the case of 720 rpm.
- Mixed flow, axial flow and propello-flow pumps.

B. Pump Casing and Impeller Wearing Rings

(a) All pumps with larger than 100 mm diameter suction and discharge nozzles should be equipped with stainless steel wearing rings on the impeller and casing.

A 1.3 ELECTRICAL

A. Power Supply

The recommended power supply is 600 Volt, 3 phase, 60 Hz.

B. Type of Starters (FV/RV)

Indicate whether the starters are full voltage or reduced voltage. Note the following:

(a) Full voltage starters are usually acceptable for motors up to and including 15 kW(m) (20 BHP). Larger motors usually have reduced voltage starters.

(b) If a standby generator is not required, motors larger than 15 kW(m) may be started full voltage if this condition is acceptable to the local Hydro.

(c) If a standby generator is required, the size of the generator depends on the motor starting as well as running current. Thus a reduced voltage starter may be required to reduce the motor inrush current and so reduce the size of the generator more in line with the continuous rating of the generator set. See MOE Spec. No. 2 for Generating Sets.

(d) NOTE: The RV starters specified are auto transformer closed transition type. These provide a favourable motor torque at starting, for the current drawn, and a smooth transfer to full voltage. This causes the least disturbance to the standby generator.

A 1.4 SKETCHES

Where practical, provide sketches and indicate on Table 1 the sketch reference or if not included.

(a) System Curve as per typical sketch.

(b) Wet Well Section with elevations. This enables the Supplier to comment if his pump requires special accommodation.

(c) Plan sketch of the pumping station showing general layout.

(d) Profile sketch of the forcemain where special features exist; e.g. siphon conditions, air releases, under river crossings.

(e) Control Panel outline and schematic if special features are required.

A 1.5 SPECIAL REQUIREMENTS

A. Pump Mechanical Shaft Seals

(a) The specified pump seal is the single mechanical seal which is recommended for most Ministry of the Environment applications.

(b) A Packing Gland type of seal should be considered on high KW (over 150 KW) or low speed pumps with a synchronous speed of 720 or 600 rpm. Provide a stainless steel sleeve on the pump shaft, a lantern ring and graphite grease lubrication. Provide a clean water feed to the lantern ring at a pressure 3 m above pump maximum delivery pressure.

B. Pressure Gauges - include the following for each pump:

(a) Discharge and suction pressure gauges equal to "Ashcroft" Duragauge No. 1279A with 150 mm. diameter dial, of a range to suit the pump delivery and suction pressures. Gauges to be liquid filled.

(b) Diaphragm seal, snubber and shut-off cock for each gauge.

STANDARD SPECIFICATION NO. 4

DRY PIT VERTICAL SEWAGE PUMPS

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STANDARD SPECIFICATION NO. 4

DRY PIT VERTICAL SEWAGE PUMPS

APPENDIX A2 - PUMP STATION GUIDELINES

A 2.0 GENERAL

A. These guidelines are to assist the Engineer in the preparation of Contract Drawings and Specifications.

B. These DO NOT form part of the requirements of the Supplier or Contractor.

A 2.1 PUMPING STATION LAYOUT

A. If the inlet sewer is deep and there is no danger of flooding basements, allow the sewage to flood back up the sewer at the wet well high level. This increases the effective wet well volume, results in a shallower station, and reduces the static head of the system.

B. In larger stations with mechanically cleaned bar screens, ensure that the screen elevates the screenings to grade level.

C. Wet well hatches should be galvanized rectangular hinged plates, to prevent them from floating off the openings, if disturbed by surges or rising fluid levels.

D. The main discharge header should be kept low in the drywell, to reduce the lengths of the individual pump discharge piping, and friction losses.

E. Provide flexibility in the piping each side of the pump casing, by using Victaulic or Dresser couplings.

F. Locate drive motors on lower floors, leaving the ground floor clear for the standby generator set(s). The driveshafts should be kept as short as possible, to eliminate steady bearings and vibration problems. The maximum recommended lengths of driveshafts (extra heavy duty class) are:

RPM	Length m.	Ins.
900	3.5	140
1200	3.0	120
1800	2.5	100

Pump Performance

G. Check the "net positive suction head" (NPSH) required by the pumps. Higher RPM pumps require a higher NPSH than lower RPM pumps. Ensure that there is sufficient NPSH available to prevent pump cavitation. The pump "best efficiency point" should be at the one-pump running condition on the system curve. Pumps will run at this condition a greater portion of their life than at the peak design pumping capacity of the station.

H. On larger stations with motors over 75 KW, variable speed pumping is required on at least two units to handle low flows or over one pump capacity. This will limit the number of starts on the motors. The second duty pump should be a constant speed unit. The second variable speed unit is then a standby.

I. Variable speed pumping may be accomplished by the following methods:

(a) Wound Rotor Motors - with two or three step speeds. The energy dissipated in the rotor resistors has been used to heat the building in one installation. The option of energy recovery by electrical feedback into the motor stator to date has proven to be too complicated and costly to maintain.

(b) Magnetic Couplings - A time proven system, but not as efficient as other alternatives.

(c) Variable Frequency Drive - The most expensive alternative, has good efficiency and the solid state equipment available from several suppliers appears to be well developed and proven in the field.

J. The required starting frequency of, say, two starts per hour for motors over 75 KW, should be specified. If not stated, motor suppliers will assume 8 starts per day i.e. one per three hours, which is inadequate.

K. The specifications for the squirrel cage motor, for highest efficiency, should require that the stator windings be random wound and the rotor be fabricated of copper bars and copper end resistance rings. The motor frame should be of cast iron or fabricated steel to reduce the ambient noise level.

Forcemain

L. For waterhammer surge suppression in long forcemains, the use of hydraulic relief valves is the preferred method, if the forcemain system permits their use.

M. Forcemain Sizing - Twin forcemains may be installed, if initial flows are low. Using one forcemain will raise flow velocities to the .75 to 1.0 m/sec range required to keep solids in suspension. Allowing the wetwell to fill and then turning a pump on at full speed is also a successful method of flushing solids along an oversized forcemain.

Electrical

N. Peak power shaving by using diesel generators does not appear to be economically feasible even in our largest stations. The maximum diesel generator size should be 1,000 kW at 1,800 RPM. Lower speed diesels are twice the cost and are not warranted for standby service. Gas turbines are not cost effective because of high specific fuel consumption and high capital and maintenance costs.

O. In a multi-generator installation, it is more economical to use a centre-fed bus system and keyed interlocks to isolate the generator sets to specific pumps. This avoids the expense of synchronization gear on the generator sets.

P. Power factor correction capacitors should be switched with the motors. They should be sized at about 15% of the motor KW rating in KVAR's. This will improve the motor full load power factor from .85 to .90 PF. The capacitors should be connected to the motor side of the motor isolation switch, to ensure that they discharge when disconnected.

Q. Pump Suction Piping

(1) Size the piping, as far as the reducer, i.e. items a, b and c below, so that the velocity will be in the range of .75 to 2.0 m/s and preferably at the lower end.

(2) The piping etc. in a site built SPS should usually consist of:

a) 90^0 Short Radius Flare Elbow (even numbers only).

b) Flanged Wall Pipe with water stop collar.

c) Gate valve, flanged ASA, iron body, bronze mounted, rising stem. (Jenkins Figure 404, Neo Metals/Seguro A1111BH or equal).
NOTE - Do NOT provide a bypass.

d) Eccentric Reducer, flanged.
NOTE - Do NOT increase over two sizes where

possible, i.e. 200 to 150 mm. Locate the reducer so that the horizontal part of the fitting is at the top.

R. Pump Discharge Piping

(1) Size the piping and valves so that the velocity will be in the range of .75 to 3.5 m/s preferably at the lower end - say 1.5 m/s, consistent with valve sizing (i.e. high cost of large valves).

(2) Size the combined riser for the combined flow of two (or more) pumps.

(3) The piping, etc. in a site built SPS (starting from the pump flange) should usually consist of:

a) Increaser, concentric, with flanges.
NOTE - Do NOT increase over two sizes if possible, i.e. 150 to 200 mm.

b) Spacer. A straight piece of pipe, 150 to 300 mm. long with one flanged end, and one grooved end to accommodate a Victaulic Coupling style 341 Vic-flange.
NOTE - This spacer is to facilitate pump removal if required and also to allow space for a larger pump in future if necessary.

c) Check valve, flanged ends, bolted cover, clear swing type with lever and spring assembly, positioned horizontally. Canada Valve Figure 52 SC-S.

d) Gate valve, flanged ends, iron body, rising stem. (Jenkins Figure 404, Neo Metals/Seguro A1111BH, or equal).

A 2.2 WET WELL

Wet Well Size

A. Size the overall volume of the wet well:

a) From the pump 20 year capacity, the sewer and forcemain elevations and the vertical spacing between the float switches.

b) To the elevations given below for on/off mode.

B. Size the plan area of the wet well:

a) To suit the overall volume required. NOTE the smaller the well dimensions, the deeper the well must be constructed, with increased costs.

b) Provide a divided wet well for flows over 100 L/s, for ease of cleaning. Provide sluice gates in the incoming channels and in the dividing wall so that either half can be dewatered while the other half is in use.

c) Extend the dividing wall up to above the station overflow level, with a catwalk at that elevation and access ladders to the bottom of each half wet well.

d) Provide level sensing for pump control and alarm in each half well by bubbler or sonic probe.

e) For variable speed pumping, as large a wet well as practical is still preferred, for the eventuality of emergency on/off pumping operations.

Wet Well Elevations

C. Recommended elevations from the bottom of the wet well to the top slab are:

a)	Bottom of the well	-	0
b)	Centre line of pump volute	-	usually 200 to 250 mm above a)
c)	Float F1 (Stop lead pump)	-	300 mm above b)
d)	Float F2 (stop lag pump)	-	Generally as c)
e)	Float F3 (Start lead pump)	-	2.5 x Q1 above c)
f)	Float F4 (Start lag pump)	-	2.5 x (Q1 + Q2) above d)
g)	Float F5 (Alarm)	-	300 mm min. above f)
h)	Influent sewer invert	-	300 mm min. above g)
i)	Service platform	-	Not less than, the sewer pipe dia. plus 125 mm above h)

j)	Top of slab	-	Between 300 & 500 mm above finished grade

D. NOTES. Re elevations above:

b) Pump volute - This elevation varies with the make and size of pump.

d) Float F2 - Usually at F1 elevation or slightly higher.

e) Float F3 - Q1 is the volume pump #1 can pump in one minute. Recommended that the minimum vertical distance between pump start and stop floats be 300 mm for stable operation.

j) Float F4 - (Q1 + Q2) is the volume both pumps, operating in parallel, can pump in one minute. It is approx. 40% more than one pump for most applications. The vertical distance between floats F3 and F4 may be 150 or 200 mm for stable operation.

h) Influent Sewer Invert - Recommend that the volume between pump stop (Float F1) and the sewer invert be at least 6 x Q1 i.e. equals 6 minutes pumping volume.

i) Service Platform - required to service floats, bubbler, pipes and lighting.

j) Top of slab - Dimension this 300 mm vertically above finished grade on the drawing.

E. Potable Water Supply

If this supply is brought to the station for flushing the wet well, provide a 19 mm wall hydrant on the outside of the building with a non-removable back flow preventer, Watts No. 8A or equal.

NOTE: Water supply connections inside the building are NOT recommended for fear of flooding the dry well.

F. Access to Wet Well

a) Access should always be from the outside, i.e. NOT from the building or dry well.

b) The access hatch should be at least 600 mm x 750 mm and should extend to the inside wall of the well.

NOTE - There should be no projection or obstruction at the top slab which would tend to make access difficult.

c) The access cover should be 5 mm galvanized steel or 6 mm aluminum plate with raised pattern and have a recessed locking device.

d) Provide access to the ladder from the top with two access posts, 38 mm aluminum, approximately 400 mm apart, and firmly secured to the outside of the entrance shaft to the wet well.

e) Walk In Access

i) Not usually considered and only if the station Q maximum is over 300 L/s and can be part of the building over the dry well.

ii) Access shall be only from the outside.

iii) If stairs are provided use aluminum type, NOT concrete.

iv) The walk-in level only may have lighting with explosion-proof fixture(s) and switched from outside or the main building.

G. Access Ladder

a) Provide an access ladder from the top slab to the service platform and a separate run from the platform to the bottom of the well.

b) The ladder construction shall be of sturdy aluminum type with wall brackets attached to the wall with 16 mm diameter galvanized cinch anchors.

c) The ladder arrangement, down to the platform, shall be:

i) Designed to the standards of the Ministry of Labour Eng/Data Sheets No. 2-04, adjusted to suit aluminum construction.

ii) Up to 6 m in length - no special features.

iii) Between 6 and 9 m. in length - provide a safety cage around the ladder OR provide an intermediate landing platform.

iv) Over 9 m in length - provide an intermediate landing platform. NOTE - The sections of

the ladder should be approximately equal in length and the ladder run broken at each landing.

v) The first rung within 200 mm of the top of the hatch.

d) The ladder arrangement from the platform to the bottom, shall be:

i) Secured to the wall, starting 1.2m above the platform, and with rungs or footholds in the benching, if required.

H. Platform

a) Provide a platform(s) to permit adequate servicing of lighting, bubbler pipes and float switches.

b) The platform construction shall be:

i) Aluminium grating suitable for a bearing load of 5kN/m^2 (100 #/sq.ft.), equal to Bordon Type B Size 6 min.

ii) Aluminum support frames for the gratings with angle supports attached to the wall with 16 mm diameter galvanized cinch anchors.

iii) Safety rails and posts of aluminum construction with stainless steel safety chains.

NOTE - Do NOT provide concrete platforms as they become slippery in service.

I. Screens

A basket screen is preferred for flows up to 115 L/s, to avoid having to enter the wet well.Mechanically cleaned bar screens are used for higher flows. Construct the basket screen similar to Drawing SK283.

J. Ventilation

Provide natural ventilation to the wet well as follows:

a) Use 100 mm diameter C.I., D.I. or Aluminum pipes, provided with a "gooseneck" at the top, extending to 1 m above the top slab and complete with insect screen.

b) For wet wells up to 8 m deep, an exit pipe only is usually provided. The bottom of the pipe projects 50 mm below the underside of the concrete slab.

c) For wet wells over 8 m deep, a second ventilator is recommended to give some form of air recirculation. Extend the bottom of the second pipe to approximately 1 m above the alarm liquid level.

d) Locate the ventilator(s) in the top slab so as not to conflict with the opening of the hatch cover. Locate the second ventilator near to the opposite side of the wet well to the exit vent.

NOTE -
Mechanical ventilation is not usually provided in wet wells in pumping stations with a capacity below 115 L/s. It is to be provided however, in larger stations,. Refer to "Wet Well/Dry Well Ventilation Safety Recommendations", Appendix A3.

If mechanical ventilation is required:

e) Provide pressurized forced ventilation, (NOT by exhaust fan).

f) Provide a centrifugal fan (equal to CB & F Baby Vent) with a totally enclosed motor and pipe the discharge down to say 1 m above the alarm liquid level.

g) Locate the fan unit on the outside wall of the building 2-5 m above grade level.

h) The fan discharge pipe should be of aluminum and enter the wet well via the top slab near to the opposite side of the well to the hatch and relief vent. DO NOT pass the pipe through the building.

i) NO VENTS from the wet well shall open into the building or be connected to the building ventilation. Locate wet well vents and building air intake louvres as far apart as possible to prevent hazardous fumes from entering the building.

A 2.3 Electrical Power

A. a) NOTE: The sewage wet well is classified as a Class I, Group D, Division II Hazardous Location and electrical work in the wet well shall comply with the appropriate portion of Section 18 of the Ontario Electrical Safety

Code. This classification should be marked on the drawing.

b) The electrical equipment should meet hazardous requirements, Class I, Group D, Division II OR be CSA approved for use in sewage wet wells.

c) Only essential equipment required to operate the station should be provided. Exclude the following:

i) Cable splices and/or junction boxes.

ii) Fans, blowers, heaters, receptacles and/or switches.

d) Conduit runs, etc. inside the wet well:

i) Arranged to enter the wet well above the overflow level and in a direct line with the run to the control panel to facilitate drawing in the cables.

ii) Conduits from the wet well to the pump control panel or lighting panel shall run through a junction box, or boxes, located outdoors.

e) Where wet well lighting is considered necessary, provide wall mounted fixtures, suitable for Class I, Group D, Division II location, coated with a corrosion resistant epoxy paint, baked-on and with stainless steel guard holding screws. (Equal to Crouse-Hinds VXHBF25GP). Locate the fixtures near the ladder or suitable access point for lamp replacement and secure to the wall with stainless steel or nylon screws.

Use an aluminium close nipple and a rigid PVC female adapter to connect the lighting fixture box to the rigid PVC conduit. Coat the nipple with epoxy paint.

f) NOTE: It is recommended that electrical equipment for flow and/or level measurement (except float switches) be located outside the well. If this, or other equipment, is required inside the well, provide Class I, Group D, Division II equipment or equipment specifically approved by Ontario Hydro for use in sewage wet wells.

B. Wiring Inside the Wet Well to Float Switches and Submersible Pumps

a) Wiring to float switches and submersible pumps is by approved Cords Type STW, SOW, SWTW, SGOW, SJOW or SWOW.

b) Sufficient cable slack is provided to permit adjustment or removal of the equipment.

c) Arrange for a cable loop where the cables leave the elbow of the conduit.

d) Where cable is run around the walls, support it by nylon clip hangers every 1.0 m maximum, secured by stainless steel or nylon screws to the wall.

e) Terminate the conduits, carrying flexible cables, where they enter the well. Terminate horizontal conduits with an elbow pointing downwards. NOTE: This places less stress on the cable.

f) DO NOT seal these conduits in the well. Allow them to breathe and drain.

g) DO NOT splice cables inside the well.

C. Conduit Runs Inside the Wet Well For Lighting, etc.

a) Provide runs to lighting fixtures and other fixed equipment (if any) in rigid PVC conduit with a green insulated copper ground wire.

b) Secure the conduit to the ceiling and/or walls with PVC clips and stainless steel or nylon screws.

c) DO NOT seal the conduits where they enter the well. Provide an open tee fitting at the conduit low point in the well to allow it to drain and breathe.

d) NOTE: Locate the switch for the well lighting in the outdoor control panel or inside a non-hazardous room. Use a circuit breaker with a ground fault circuit interrupter.

D. Conduit Runs from Junction Box to Wet Well

a) Run rigid PVC conduits from the bottom of the junction box to the wet well. Run the

conduits outdoors or underground NOT through a non-hazardous room.

b) Slope the horizontal runs so as to drain any moisture into the well.

c) After wiring, seal the end of the conduit at the junction box with a "Duxseal" mastic plug.

d) Provide the conduits large enough so that one flexible cable can be replaced without damaging other flexible cables in the same run.

e) Provide separate conduits for, and with recommended minimum sizes:

- Float cables, 25 mm minimum for 2 cables, 37 mm minimum for 3 cables.

- Lighting runs, etc., 19 mm minimum.

E. Junction Boxes

a) Provide a rigid PVC junction box, or boxes, outdoor weather-proof type for all sensor and lighting conductors going to the wet well.

b) Ensure the box is adequately sized to permit splicing of the conductors under in-service conditions, without damaging the other conductors.

c) Locate the box outdoors with at least 1 m clearance above grade and preferably not more than 10 m from the wet well. Position the box to present few bends in the conduit runs to the wet well.

d) Splice all wires inside the junction box with insulated compression connectors and then taped with approved insulation tapes or heat-shrinking tubing. Number the wires on each side of the splice with numbered tape markers.

F. Conduit Runs from Junction Box to Control Panel, etc.

a) Provide conduit seal fittings, straight or angle type, at the junction box.

b) Run PVC conduit from the seal fitting to the control panel, etc.

c) After the building wires are installed, tested and the installation approved, install the cement in the seal fittings.

d) NOTE: Where the junction box and rigid PVC conduit, located outdoors, is subject to vandalism and/or mechanical vehicular damage, protect the conduit and box with a metal shield or guard.

e) Where acceptable, provide a receptacle outside the wet well near the access hatch for a portable trouble light for use in the well, e.g. on the outside wall of the building.

A 2.3 Level Sensors

A. Float Switches & Hanger Support

a) Locate the float hanger on the wet well wall, 1 m above the platform and so that the floats are away from the direct turbulence of the influent sewer. Secure the hanger to the wall with cinch anchors. Cut a slot or holes in the platform for the float cables whenever the floats cannot be pulled up directly.

b) Indicate the elevations of the float switches. For clarity, indicate these elevations as being at the bottom of the floats.

c) Indicate the location of the sway control rings at 300 mm above the neck of the floats. NOTE - the floats should be 300 to 450 mm apart in the horizontal plane and held apart by the sway control rings so as to prevent the float cables from becoming snarled or tangled.

d) The high level alarm should be float switch, NOT bubbler. The switch should have normally open and normally closed contacts. Equal to "Flygt ENH-10". Connect to alarm terminal box in the control room.

e) The low level alarm is NOT normally required. Provide only with Ministry written agreement.

B. Bubbler Control Pipe if required:

a) Provide a 19 mm rigid PVC pipe, threaded at each end, through the wall into the wet well and to extend 100 to 150 mm beyond each face of the wall.

b) Locate this wall stub say 1 m above the wet well platform and say 300 mm from the inside of the station wall.

c) Connect a 19 mm PVC union to the wall stub in the wet well and a 19 mm PVC tee and nipple to the union. Plug the upper end of the tee (which is removed for "rodding" the pipe). The vertical pipe should be 300 mm from the dividing wall.

d) Connect the lower end of the tee, via a coupling, to 19 mm rigid PVC pipe. Extend the PVC pipe down to 450 mm approx. above the wet well floor.

e) Provide a flange coupling, with neoprene gasket, on the bottom 3 m length of the pipe.

f) Support the vertical run of pipe to the wall every 1-1/2 m approx. with rigid wall brackets, e.g. 50 x 50 x 6 mm angle.

g) See clause A2.3 C4 for bubbler piping outside the wet well.

C. Pump Control by Air Bubbler

1. If bubbler pump control is required, provide the following assemblies:

   a) Air compressor, supported on wall brackets, located in the mezzanine or generator room and arranged for easy service.

   b) Air line controls located on a 19 mm plywood backboard in the mezzanine close to and in the line from the compressor.

   c) Air line to wet well.

   d) Pump control switches etc. located on or in the 120 v. section of the pump control panel.

2. Air Compressor Assembly. Include the following:

   a) Compressor, 0.66 L/s minimum capacity, close coupled piston type, (not vane).

   b) Motor, 1/8 KW min. 1725 rpm, split-phase, built-in thermal protector, drip-proof, 115 v., 1 ph. service, suitable for starting compressor under all conditions.

   c) Receiver, 8L capacity min., tested to 1035 kPa, drain cock, piped to exterior of cabinet.

d) Motor control pressure switch, rugged, adjustable 172-450 kPa range.

e) Accessories to complete i.e. pressure gauge, shut-off valve, pressure relief and check valves, inlet filters, etc.

f) Comply with Safety Regulations and equal to Bell & Gossett Model BLCT.

3. Air Line Controls. Include the following:

a) Pressure reducing valve, set at 100 kPa, equal to 6 mm Fisher type 67FR with handwheel and cellulose filter element; range - 0-415 kPa.

b) Visual glass tube, variable area type flow indicator with direct reading scale: 0-1 L/min. approximately. Equal to Fischer & Porter Rotameter Model 10A3135.

c) Pressure gauge; 64 mm dia. with cock. Equal to Ashcroft Type 1000, 0-60 psig range.

d) Needle valve.

e) Air line strainer.

4. Air Line to Wet Well

a) Provide 9 mm copper tubing type K from the air line controls to 19 mm PVC stub pipe which passes through the wall into the wet well.

b) NOTE - If the pipe through the wall to the wet well is below the overflow elevation provide an anti syphon loop in the copper tubing before connecting it to the wall pipe. The top of the loop is to be above the overflow elevation or the max. possible level in the wet well.

c) See clause A2-3B for the bubbler pipe inside the wet well.

d) All piping and connections are to be leak-proof.

5. Pump Control Switches, etc. Include the following:

a) Two pressure switches, one for each pump, to stop and start the pumps, mercury tube sensitive element type, independent range

and differential adjustment, to suit the operating levels of the station, equal to Honeywell "Pressuretrol type L404B or Vaporstat L408B".

b) Well level gauge indicator, 115 mm dial, scaled in millimeters of water column so that maximum water level equals approximately 80% of scale and equal to Ashcroft Type 1000.

APPENDIX A3

WET WELL/DRY WELL VENTILATION SAFETY RECOMMENDATIONS
EXISTING OR NEW CONSTRUCTION

A. Wet Well Areas* with Drypit Pumping Equipment

Design wet wells with drypit pumping equipment to meet the following conditions:

1. Provide all wet wells with forced ventilation systems which introduce air and provide cross ventilation to the area. Provide a manual on/off switch for maintenance purposes. Terminate fresh air ducting one (1) metre above the normal high liquid level of the area. Where necessary, locate a gravity louvre in the ducting to allow ventilation during periods of flood conditions in the wet well. Locate the exhaust openings at the opposite end or side of the wet well from the intake ducting, to prevent the recirculation of exhaust fumes.

2. Provide sewage pumping station wet wells (peak flows less than 115 L/s) with a forced air system capable of supplying a MINIMUM of ten (10) air changes per hour to the area.

   Equip wet wells at larger installations (peak flows greater than 115 L/s) with a two speed ventilation fan to provide a MINIMUM of ten (10) air changes per hour at low speed and a MINIMUM of twenty (20) air changes per hour at high speed.

3. Design wet well ventilation equipment with the capability of continuous service. In northern climates, switch fans off in severe cold weather.

4. Provide access openings from the outside only, with a minimum size of 750 mm x 900 mm (30" x 36") to permit easy entry and egress in an emergency while using personal protective equipment.

5. Where pumping or control equipment is installed over wet wells, ensure that there are no openings between the two areas, and all conduits are sealed. Route all electrical conduits from

*NOTE: Sewage pumping station wet wells have been classified as Class I, Group D, Division II hazardous locations to Section 18 of the Ontario Electrical Safety Code.

the wet well to a junction box located in the open air or on the exterior of any permanent structure. Provide a gas tight seal between the junction box and electrical switchgear using EYS fittings filled with a sealing compound approved by Ontario Hydro.

B. Dry Well Areas with Drypit Pumping Equipment

1. Equip dry wells with a forced air ventilation system to provide a MINIMUM of five (5) air changes per hour to the area with ducting from the fan to terminate 1 metre from the dry well floor. Provide manual controls for intermittent operation.

   Install ducting to provide cross-ventilation to the dry well. Ducting shall be completely separate from any other area.

C. Wet Well with Submersible Pumping Equipment

Design wet wells with submersible pumping equipment to meet the following conditions:

1. Provide ventilation by a 100 mm or 150 mm (4" or 6") diameter goose-neck breather, equipped with a fitting that will allow connection of 200 mm (8") diameter hose from a portable fan, or lower portable fan flexible discharge hose to working level.

2. Mount the electrical pump controls and all other electrical switchgear above ground in the open air.

3. If the electrical switchgear is housed over the wet wells, ensure that there are no openings between the two areas and all conduits are sealed. Ensure that switchgear and conduits do not interfere with wet well access and egress. Route all electrical conduits from the wet well to a junction box located in the open air or on the exterior of any permanent structure. Provide a gas tight seal between the junction box and motor starters using EYS fittings and a sealing compound approved by Ontario Hydro.

4. Avoid installing any equipment other than pumps and level controls, (such as fixed bar screens) in the wet well, which will require personnel to enter for inspection, cleaning, or other work on a regular basis. If screening is required, a removable basket screen is preferred, for small

stations with flows of less than 115 L/s and a mechanically cleaned bar screen is preferred for larger stations.

5. Provide an access hatch opening to the outside only with a minimum size of 750 mm x 900 mm, (30" x 36") to permit easy entry and egress in an emergency while using personal protective equipment.

D. Detection Equipment

1. Where possible, or desirable, fit detection equipment to detect hazardous gases in wet wells having mechanical ventilation equipment and to actuate an alarm and/or the ventilation equipment. Where detection equipment is not installed, use portable gas testing equipment.

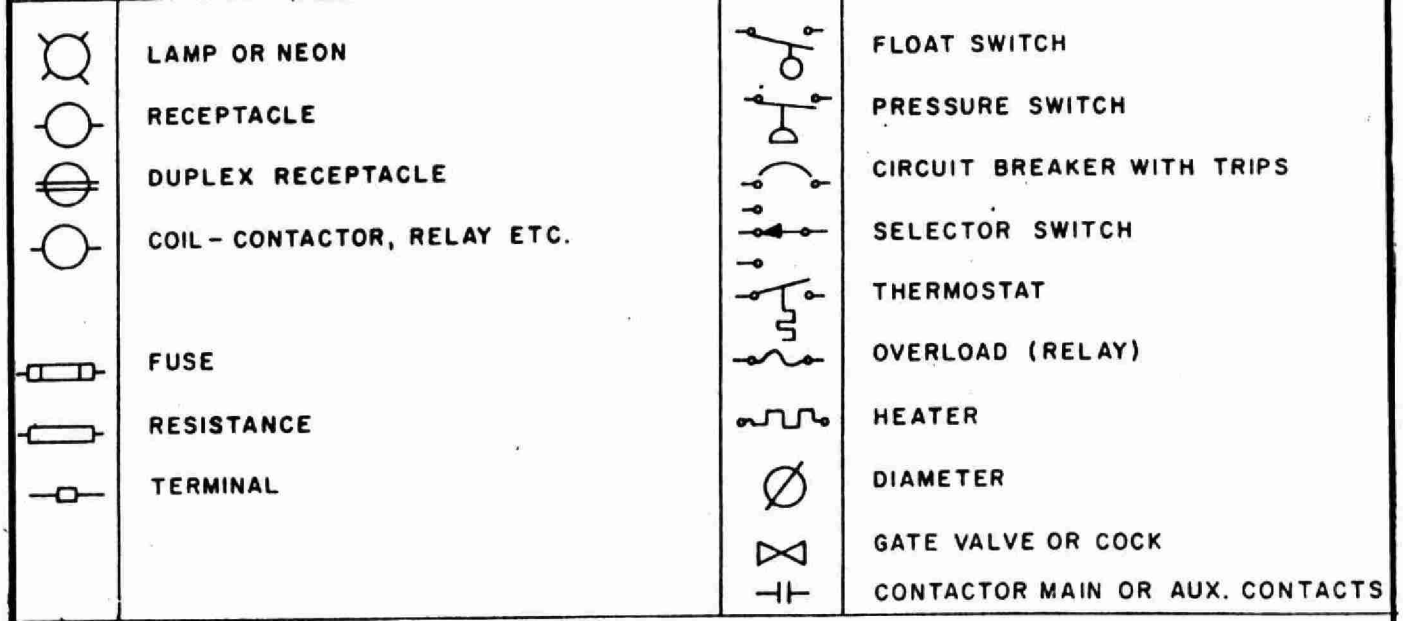
2. Locate readouts for the detection equipment outside the area of possible hazard.

NOTE: For further information on the design of Sewage Pumping Stations, refer to the Ministry "Guidelines for the Design of Sanitary Sewage Systems", dated July 1984, Pages 29-44; "Submersible Sewage Pumps", Specification No. 3, March 1984, Appendix A1 and A2 and "Dry Pit Vertical Sewage Pumps", Specification No. 4, March 1986, Appendix A1 and A2.

LEGEND

B.T. Co.	BELL TELEPHONE Co.
CHGRS	CHARGERS
FL	FLOAT SWITCH
FV	FULL VOLTAGE (STARTER)
G	GAUGE
GND.DET	GROUND DETECTOR
HOA	HAND - OFF - AUTO SELECTOR
I/L	INTERLOCK
IND	INDICATOR
JCT	JUNCTION
L	LAMP
MI	CONTACTOR Nº I
MFM	MAGNETIC FLOW METER
MS	MOTOR STARTER
N	NEON INDICATOR, NEUTRAL
OL	OVERLOAD (RELAY)
PRV	PRESSURE REDUCING VALVE
PWR	POWER
R	RUN
REC.	RECORDER
RV	REDUCED VOLTAGE (STARTER)
S	START
SWS	SWITCHES
TC	TIMED CLOSING
TO	TIMED OPENING
TRI	TIME DELAY RELAY Nº I
TT	TIME TOTALISER (ETM)
TRANS	TRANSFORMER
V	VALVE
Y	WYE
'Z'	TERMINAL FOR GEN. SET INTERLOCK RE. NON ESSENTIAL LOADS

SYMBOLS

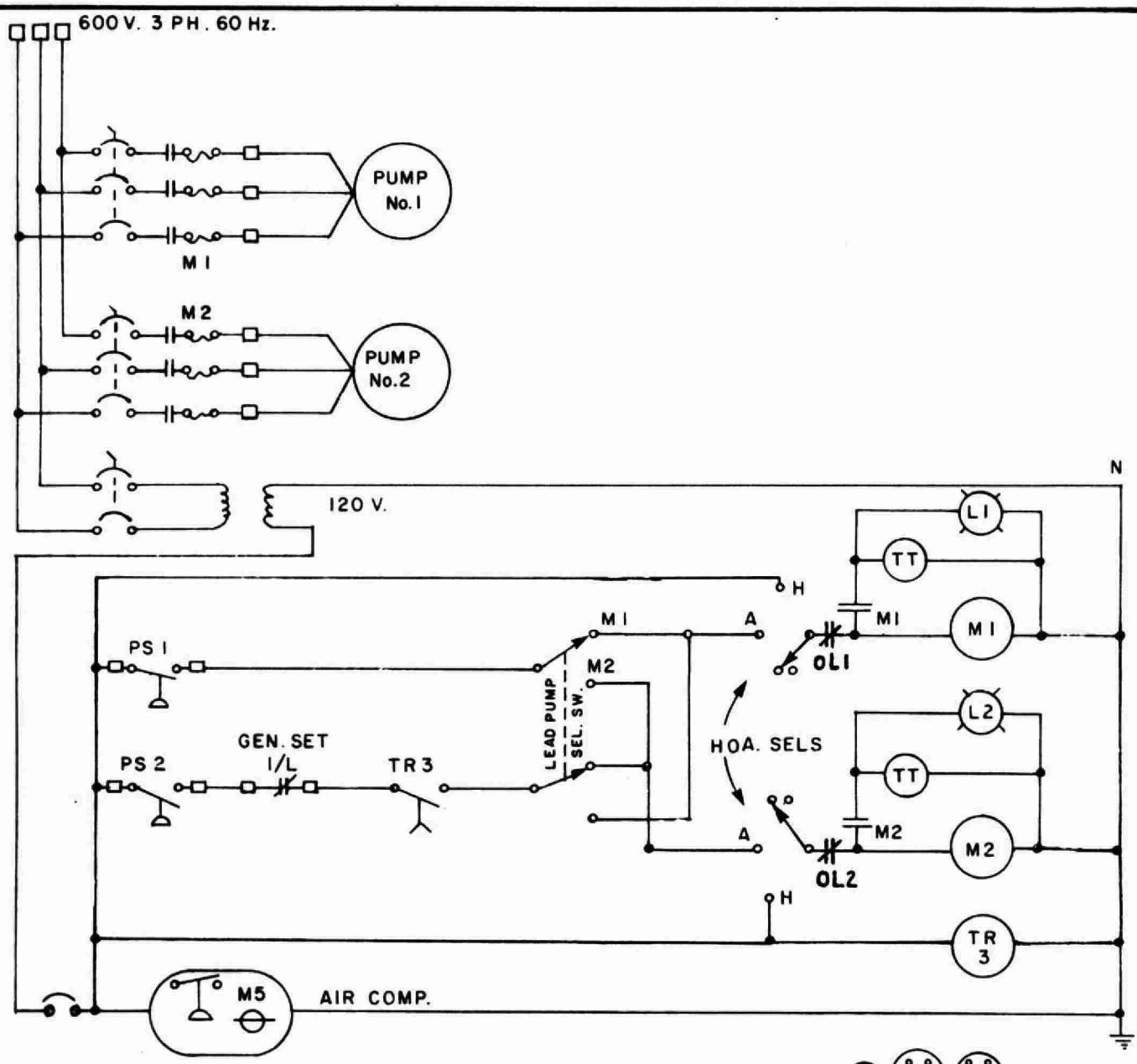


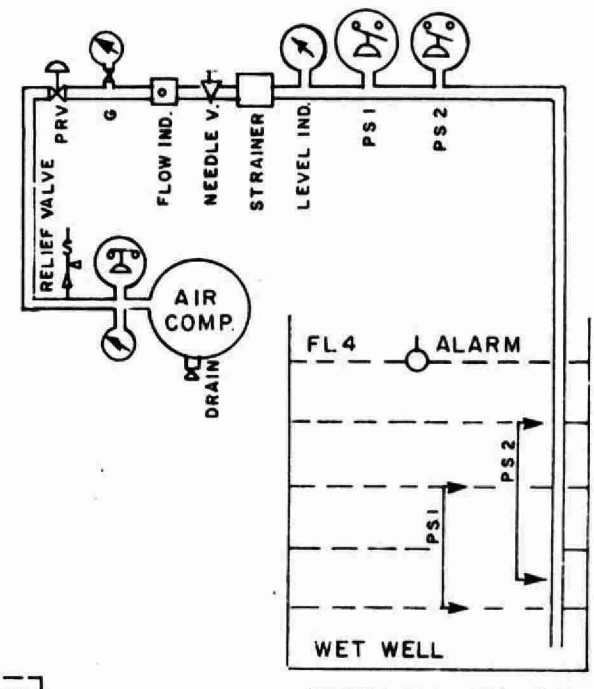
NOTE: CONTROL OF REDUCED VOLTAGE CLOSED TRANSITION STARTERS SHOWS BASIC FUNCTION ONLY AND IS NOT COMPLETE IN DETAIL

LEGEND FOR CONTROL SCHEMATICS AND SKETCHES

ENVIRONMENT ONTARIO
ENV APPROV & PROJ ENG BR

SS No 4 Aug/83 SK 351





BUBBLER CONTROL

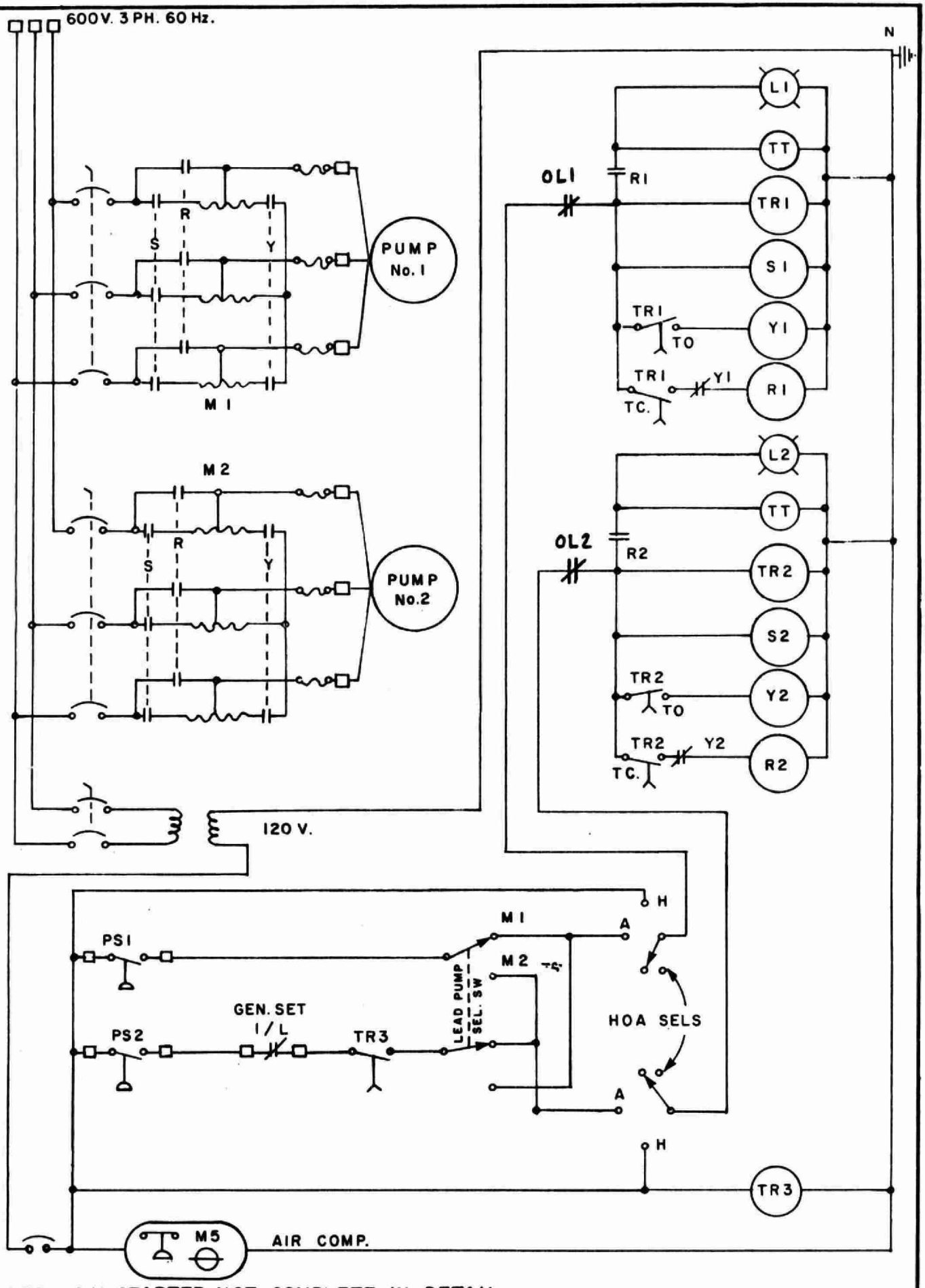
FL4

NOTE - BUBBLER SWITCHES HAVE ADJUSTABLE DIFFERENTIAL

HIGH LEVEL ALARM TO SEPARATE JCT. BOX

SITE - BUILT
SEWAGE PUMPING STATION
TYPICAL CONTROL SCHEMATIC
BUBBLER CONTROL & F.V. STARTERS

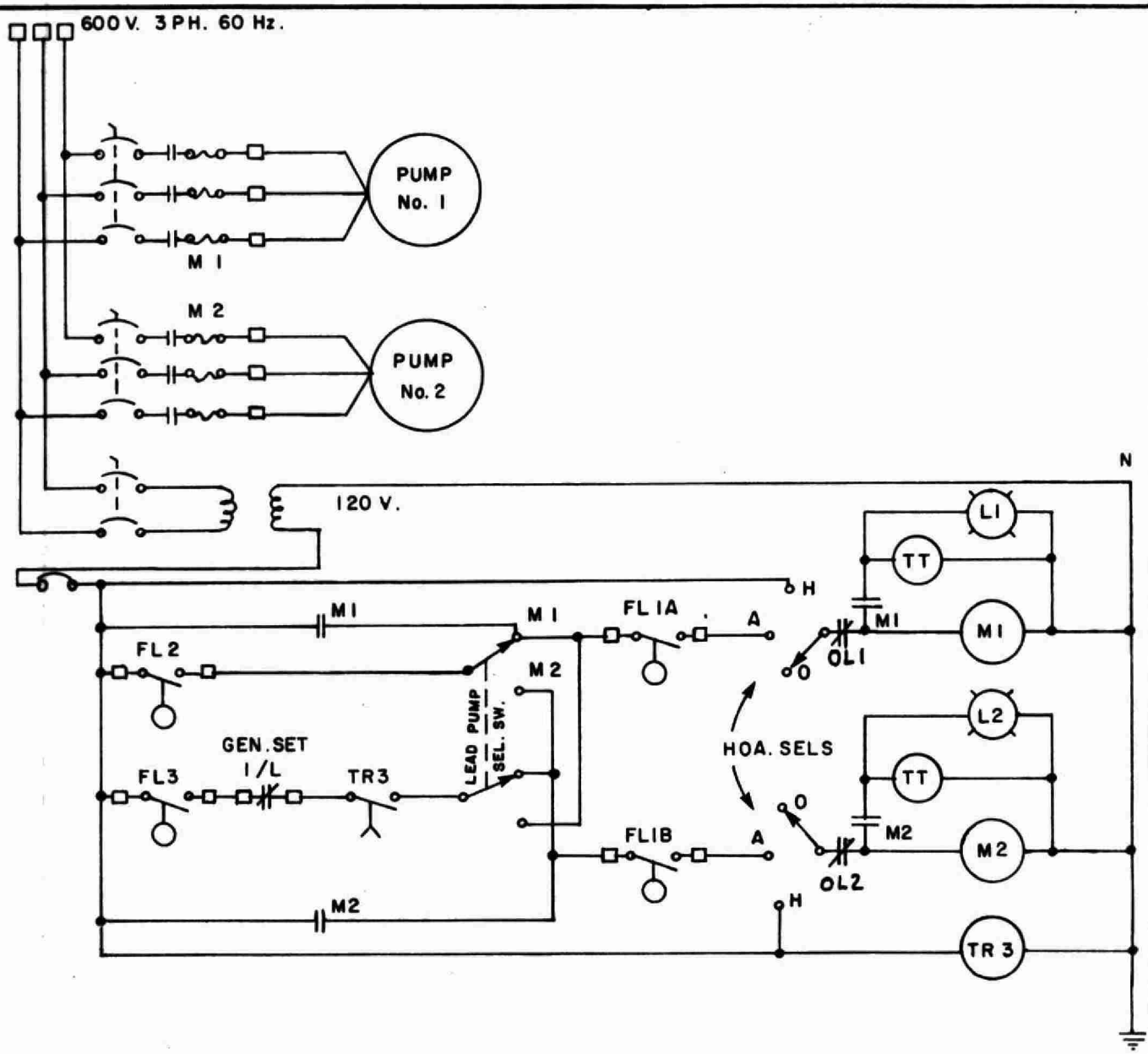
ENVIRONMENT ONTARIO
ENV APPROV & PROJ ENG BR
SS No.4 JAN. 1980 SK. 152

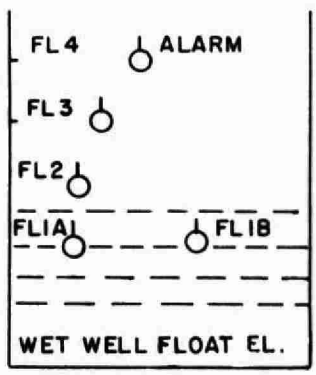


NOTES : R.V. STARTER NOT COMPLETE IN DETAIL
BUBBLER SWITCHES HAVE ADJUSTABLE DIFFERENTIAL

SITE - BUILT
SEWAGE PUMPING STATION
TYPICAL CONTROL SCHEMATIC
BUBBLER CONTROL & R.V. STARTERS

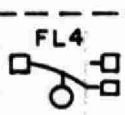
ENVIRONMENT ONTARIO
ENV APPROV & PROJ ENG BR
SS No. 4 JAN. 1980 SK. 153





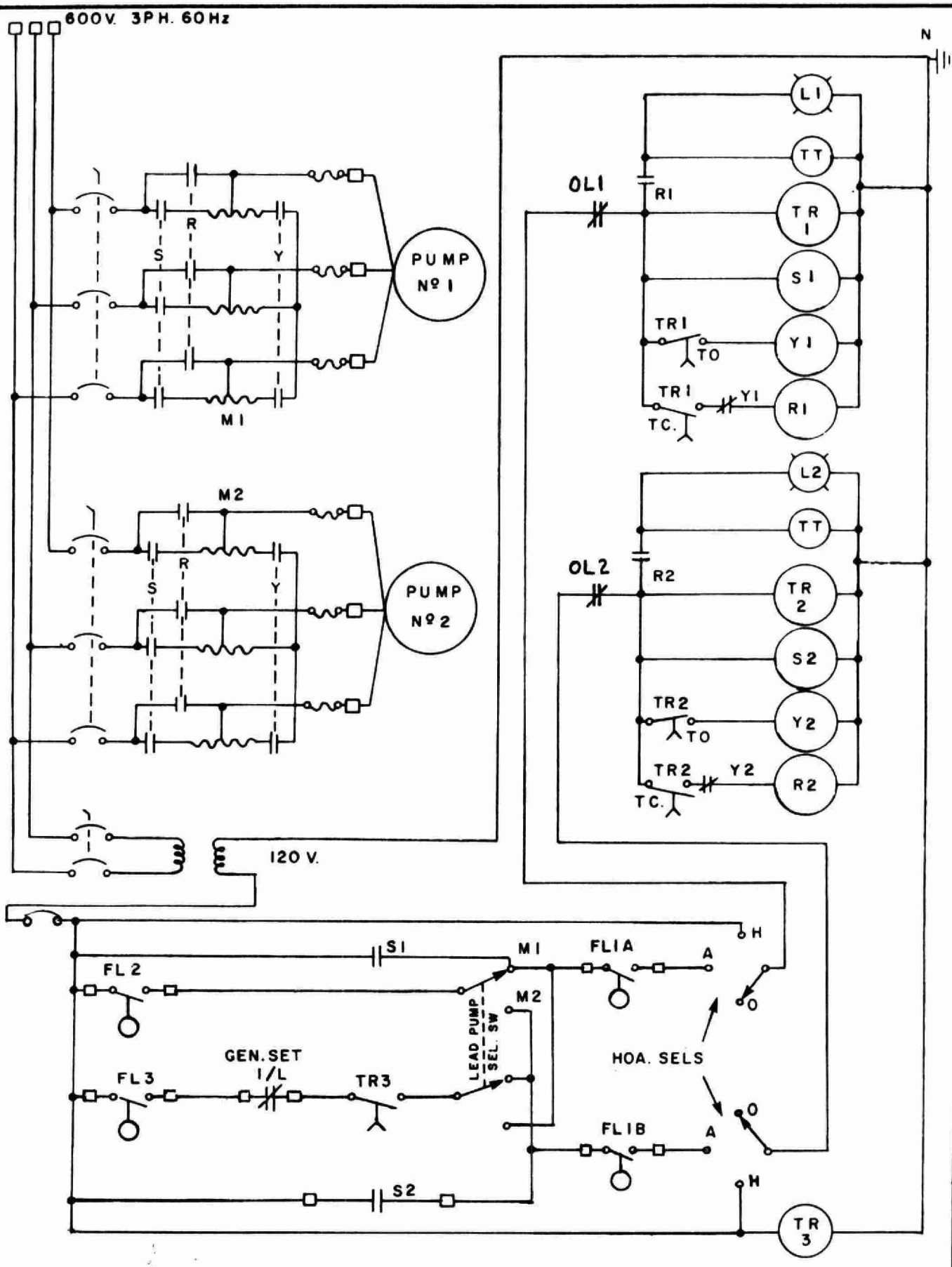
NOTES : FL1A & FL1B SET AT APPROX. SAME ELEVATION

MS1 & MS2 HAVE INDEPENDENT LOWLEVEL CUT-OFF FLOATS



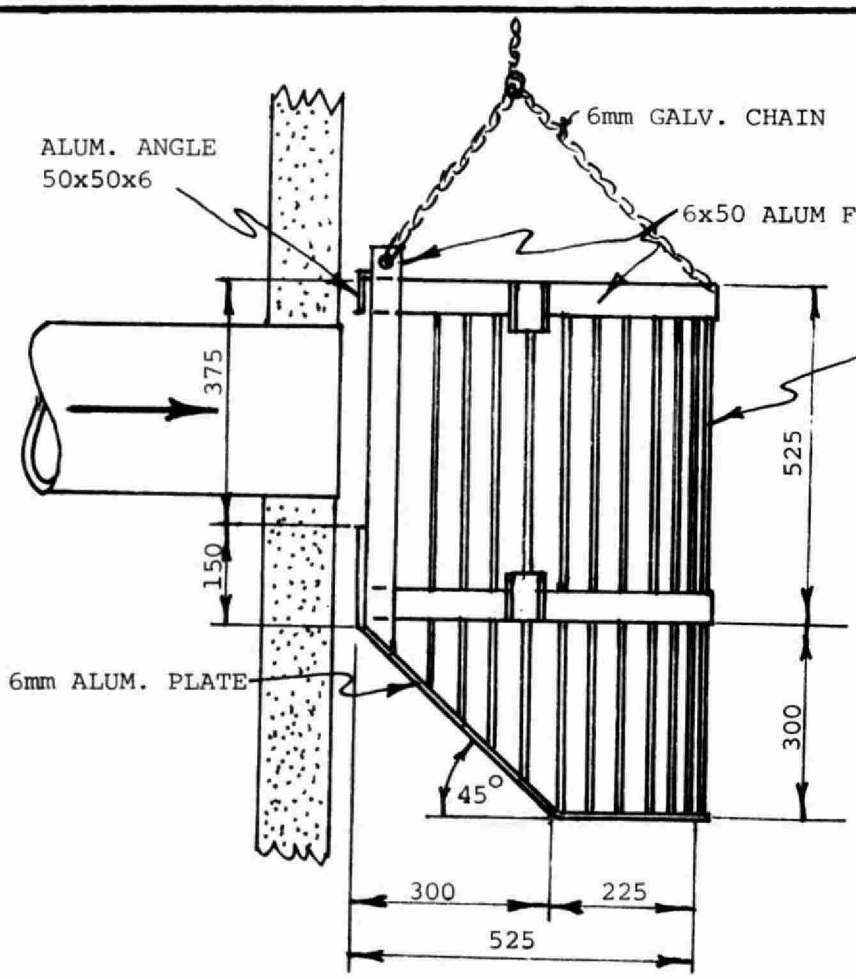
HIGH LEVEL ALARM TO SEPERATE JCT. BOX

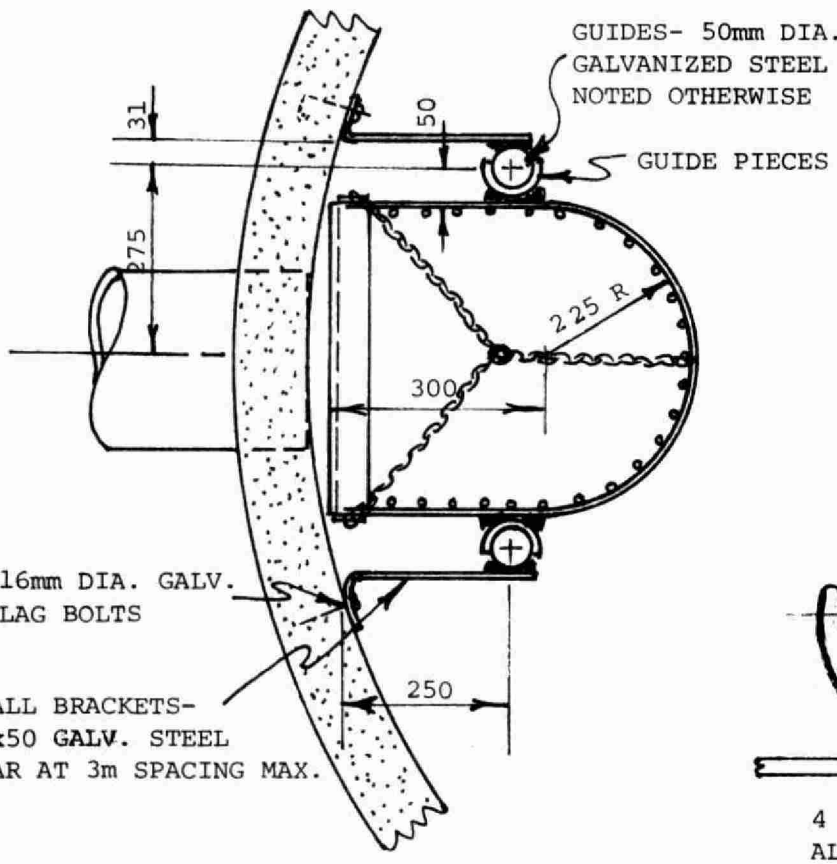
SITE – BUILT SEWAGE PUMPING STATION TYPICAL CONTROL SCHEMATIC FLOAT CONTROL & F.V. STARTERS	ENVIRONMENT ONTARIO ENV APPROV & PROJ ENG BR SS No.4 JAN. 1980 SK 154

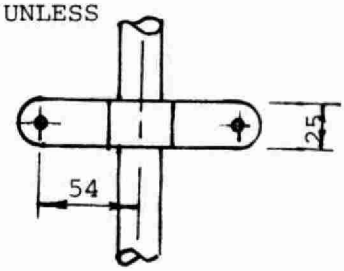


NOTES: R.V. STARTER NOT COMPLETE IN DETAIL
MS1 & MS2 HAVE INDEPENDENT LOW LEVEL CUT-OFF FLOATS

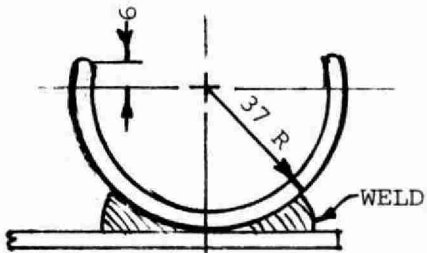
SITE - BUILT **SEWAGE PUMPING STATION** TYPICAL CONTROL SCHEMATICS FLOAT CONTROL & R.V. STARTERS	ENVIRONMENT ONTARIO ENV APPROV & PROJ ENG BR SS No. 4 JAN. 1980 SK. 155





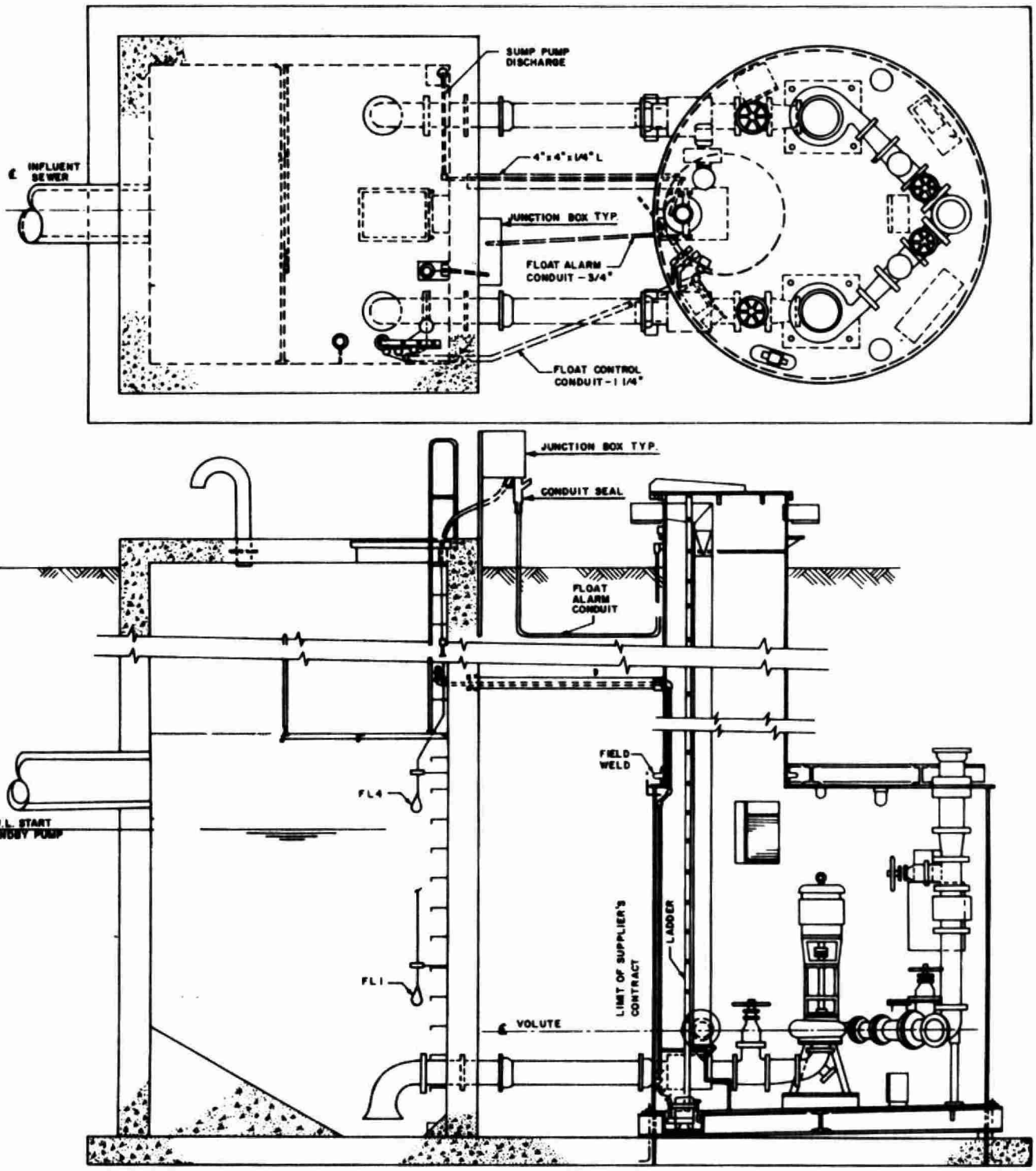


2 LOWER STOPS- PIPE CLAMPS, GRINNEL FIG. 21, GALVANIZED

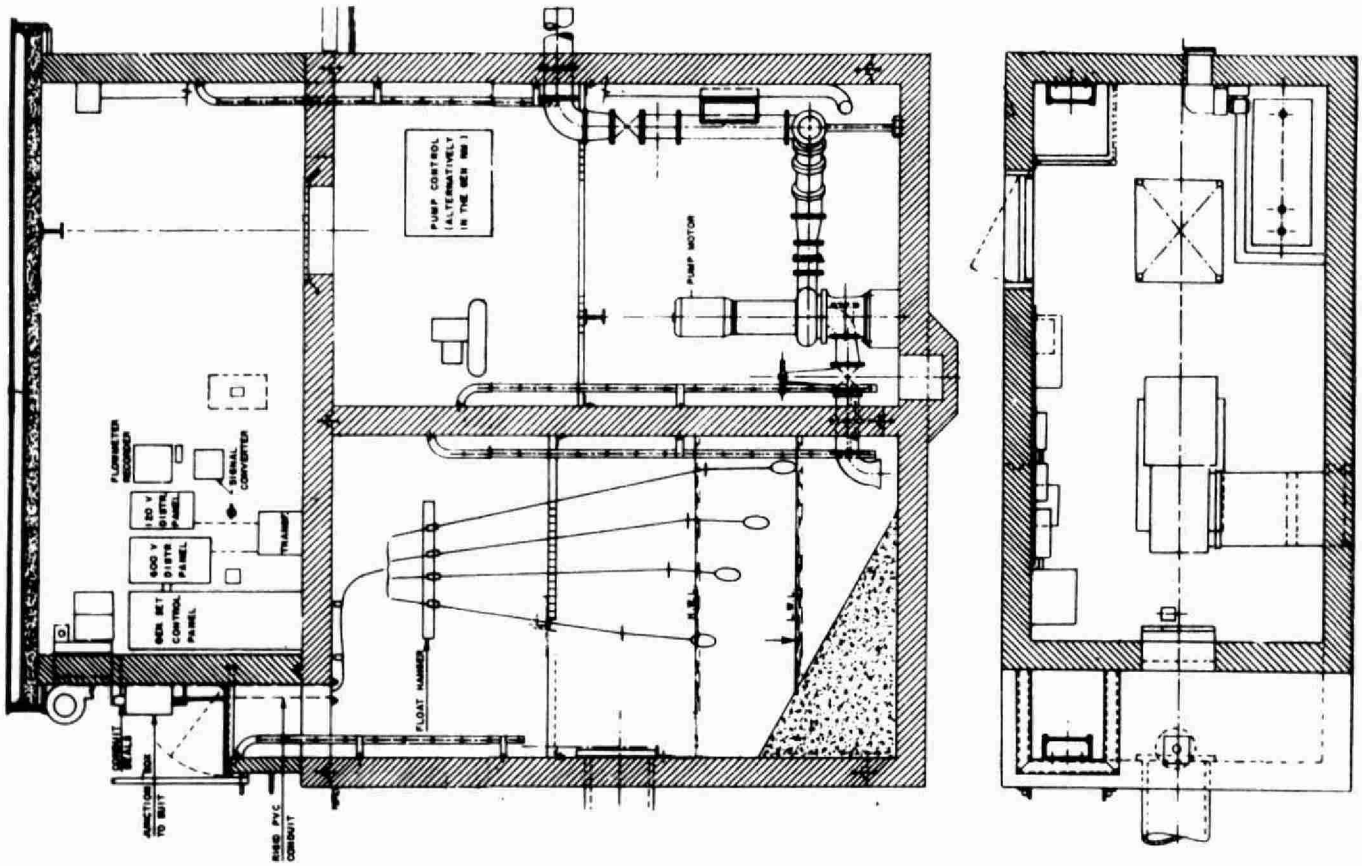


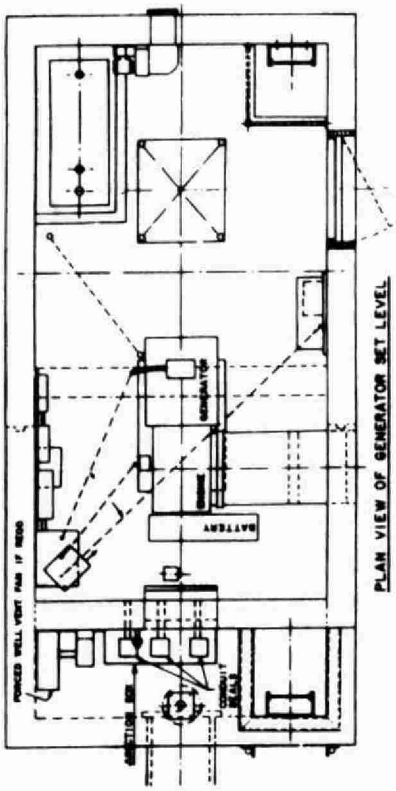
4 GUIDE PIECES, 64mm DIA. ALUMINUM PIPE, SCHEDULE 40, 75mm WIDE

Scale: 1:12	SEWAGE PUMP STATION BASKET SCREEN - DETAILS	ENVIRONMENT ONTARIO ENV APPROV & PROJ ENG BR. SS NO 4 Aug/80 SK 283

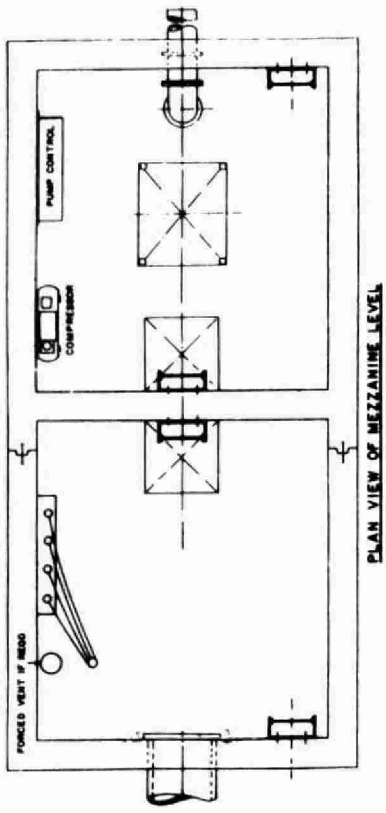


	FACTORY BUILT U/G PUMPING STATION	ENVIRONMENT ONTARIO ENV APPROV & PROJ ENG BR 79 OCTOBER, SKETCH 378

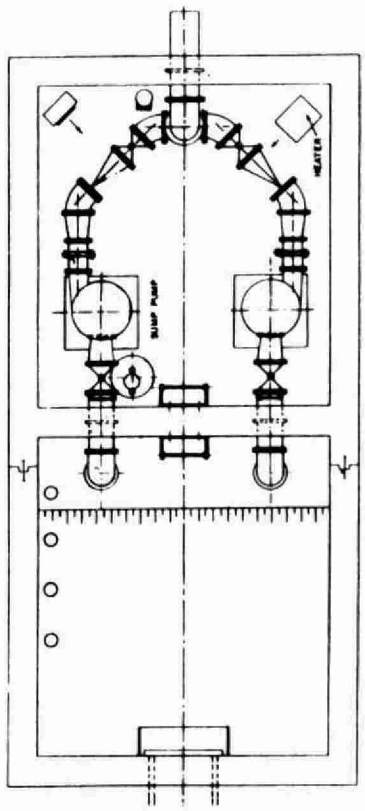




PLAN VIEW OF GENERATOR SET LEVEL



PLAN VIEW OF MEZZANINE LEVEL



PLAN VIEW OF PUMP LEVEL

	SITE BUILT SEWAGE PUMPING STATION **TWO PUMPS & GENERATING SET** **ELECTRICAL EQUIPMENT LAYOUT**	**ENVIRONMENT ONTARIO** ENV APPROV & PROJ ENG BR 79 OCTOBER, SKETCH 379